

# IBM eXFlash DDR3 Storage DIMMs

## IBM Redbooks Product Guide

IBM® eXFlash memory-channel storage is the newest innovative flash memory technology that IBM introduces with new X6 family servers. The eXFlash memory-channel storage is a high-performance solid-state storage device in a standard DIMM form factor that plugs into existing memory DIMM slots and is directly connected to the DDR3 system memory bus.

This new technology allows supported IBM System x® servers to close the performance gap in storage I/O and deliver break-through performance for targeted workloads, such as analytical workloads, transactional databases, and virtualized environments. IBM eXFlash DIMMs offer significantly lower latency compared to traditional solid-state devices, such as IBM eXFlash SSDs and even PCIe SSD adapters.

The following figure shows the IBM eXFlash DDR3 Storage DIMM.



Figure 1. IBM eXFlash DDR3 Storage DIMM

### Did you know?

- IBM eXFlash memory-channel storage is the industry's first flash memory device where data is transferred from the flash memory to the system memory directly through the DDR3 memory bus.
- IBM eXFlash memory-channel storage provides scalable performance by using an array of eXFlash DIMMs in a parallel manner.
- IBM eXFlash DIMMs feature IBM WriteNow technology that helps to deliver as low as 3.3 microseconds write latency.
- With FlashGuard protection, IBM eXFlash DDR3 Storage DIMMs can be fully rewritten up to ten times per day throughout their entire five-year life expectancy.
- Rigorous testing of eXFlash DDR3 Storage DIMMs by IBM through the IBM ServerProven® program ensures a high degree of confidence in storage subsystem compatibility and reliability. Providing additional peace of mind, these modules are covered under IBM warranty.

## Part number information

The following table lists the information for ordering part numbers and feature codes.

Table 1. Ordering part numbers and feature codes

Description	Part number	Feature code
IBM eXFlash 200GB DDR3 Storage DIMM	00FE000	A4GX
IBM eXFlash 400GB DDR3 Storage DIMM	00FE005	A4GY

The part numbers for the eXFlash DDR3 Storage DIMMs include the following items:

- One eXFlash DIMM module
- Documentation CD
- Technical Flyer
- Warranty Flyer
- *Important Notices* document

## Features

Here are the key features of the eXFlash memory-channel storage:

- Ultra-low write latency with IBM WriteNow technology
  - o As low as 3.3 microseconds response time
  - o Less wait time between transactions
  - o Deterministic response time across varying workloads
  - o Tight standard deviation on performance
  - o Consistent performance for highest throughput and speed
- RAID mirroring
  - o Allows two eXFlash DIMMs in the system domain to be a mirrored pair
  - o Can protect business-critical data
- High scalability
  - o Add multiple eXFlash DIMMs without experiencing performance degradation
  - o Highest flash memory density within the server
- Maximized storage footprint with usage of existing unused DDR3 slots
  - o Increases storage capacity without increasing your servers
  - o Features industry-standard DDR3 form factor
  - o Plugs into an existing DDR3 slot

IBM eXFlash DIMMs are recognized by the server as solid-state storage devices like many other block storage devices. A specialized kernel driver is required for the operating system to use eXFlash DIMMs.

IBM eXFlash DIMMs have the following key characteristics:

- Industry standard LP DIMM form factor supports standard DDR3 memory DIMM slots on selected System x servers.
- Uses cost-effective 19 nm MLC NAND technology with FlashGuard technology for high read and write performance to fulfill client needs in the enterprise space.
- High endurance, with up to 10 drive writes per day (DWPD) during a 5-year lifecycle to withstand applications with intensive read/write workloads.
- Up to 12.8 TB total flash memory-channel storage capacity per server.
- Support of up to 1600 MHz DDR memory speeds and the usage of available DDR3 memory channels.
- Support for intermixing with standard registered memory DIMMs (RDIMMs) on the same memory channel.
- FlashGuard technology extends the native endurance of commercial-grade MLC flash memory by using the following features:
  - o Aggregated Flash Management
  - o Advanced Signal Processing
  - o Enhanced Error Correction
- DataGuard technology protects against data corruption and loss by using the following features:
  - o Full data path protection
  - o Flexible Redundant Array of Memory Elements (F.R.A.M.E.) data recovery algorithm
- EverGuard technology protects data in the event of unplanned power outages.

Solid-state storage has a huge but finite number of program/erase (P/E) cycles, which affects how long it can perform write operations and thus its life expectancy. Solid-state device write endurance is typically measured by the number of program/erase cycles that the device can incur over its lifetime, which is listed as Total Bytes Written (TBW) or Drive Writes Per Day (DWPD) in the device specification.

The TBW value that is assigned to a solid-state device is the total bytes of written data that a drive can be guaranteed to complete. Reaching this limit does not cause the drive to immediately fail; the TBW simply denotes the maximum number of writes that can be guaranteed. A solid-state device does not fail upon reaching the specified TBW, but at some point after surpassing the TBW value (and based on manufacturing variance margins), the drive reaches the end-of-life point, at which time the drive will go into read-only mode. Because of such behavior, careful planning must be done when you use SSDs in application environments to ensure that the TBW of the drive is not exceeded before the required life expectancy is reached.

## Technical specifications

The following table presents technical specifications for the IBM eXFlash DDR3 Storage DIMMs.

Table 2. IBM eXFlash DDR3 Storage DIMM technical specifications

Feature	200 GB	400 GB
Part number	00FE000	00FE005
Interface	DDR3 up to 1600 MHz	DDR3 up to 1600 MHz
Hot-swap device	No	No
Form factor	LP DIMM	LP DIMM
Capacity	200 GB	400 GB
Endurance	Up to 10 drive writes per day (5-year lifetime)	Up to 10 drive writes per day (5-year lifetime)
Data reliability	< 1 in 10 <sup>17</sup> bits read	< 1 in 10 <sup>17</sup> bits read
IOPS reads*	_**	125,000
IOPS writes*	_**	43,000
Sequential read rate	_**	645 MBps
Sequential write rate	_**	515 MBps
Read latency	_**	144 µs
Write latency	_**	As low as 3.3 µs
Shock	200 <i>g</i> , 10 ms	200 <i>g</i> , 10 ms
Vibration	2.17 <i>g</i> rms 7-800 Hz	2.17 <i>g</i> rms 7-800 Hz
Maximum power	12 W	12 W

\* 4 KB block transfers

\*\* 200 GB eXFlash DIMM performance specifications are planned to be published later in 2014.

## Supported servers

The following table lists the compatibility information for the IBM eXFlash DDR3 Storage DIMMs and System x and IBM iDataPlex® servers.

Table 3. System x, iDataPlex, and NeXtScale compatibility (part 1 of 2)

Part number	Description											
		x3250 M5 (5458)	x3500 M4 (7383, E5-2600 v2)	x3530 M4 (7160, E5-2400 v2)	x3550 M4 (7914, E5-2600 v2)	x3630 M4 (7158, E5-2400 v2)	x3650 M4 (7915, E5-2600 v2)	x3650 M4 BD (5466)	x3650 M4 HD (5460)	x3850 X6/x3950 X6 (3837)	dx360 M4 (7912, E5-2600 v2)	nx360 M4 (5455)
00FE000	IBM eXFlash 200GB DDR3 Storage DIMM	N	N	N	N	N	Y*	N	N	Y	N	N
00FE005	IBM eXFlash 400GB DDR3 Storage DIMM	N	N	N	N	N	Y*	N	N	Y	N	N

\* Support is limited. See "IBM System x3650 M4 considerations"

Table 3. System x, iDataPlex, and NeXtScale compatibility (part 2 of 2)

Part number	Description	x3100 M4 (2582)	x3250 M4 (2583)	x3300 M4 (7382)	x3500 M4 (7383, E5-2600)	x3530 M4 (7160, E5-2400)	x3550 M4 (7914, E5-2600)	x3630 M4 (7158, E5-2400)	x3650 M4 (7915, E5-2600)	x3690 X5 (7147)	x3750 M4 (8722)	x3850 X5/x3950 X5 (7143)	dx360 M4 (7912, E5-2600)
00FE000	IBM eXFlash 200GB DDR3 Storage DIMM	N	N	N	N	N	N	N	N	N	N	N	N
00FE005	IBM eXFlash 400GB DDR3 Storage DIMM	N	N	N	N	N	N	N	N	N	N	N	N

The following table lists the compatibility information for the IBM eXFlash DDR3 Storage DIMMs and IBM BladeCenter® and IBM Flex System™ servers.

Table 4. BladeCenter and Flex System compatibility

Part number	Description	HS12 (8028)	HS22 (7870)	HS22V (7871)	HS23 (7875, E5-2600)	HS23 (7875, E5-2600 v2)	HS23E (8038)	HX5 (7872)	HX5 (7873)	x220 (7906)	x222 (7916)	x240 (8737, E5-2600)	x240 (8737, E5-2600 v2)	x440 (7917)
00FE000	IBM eXFlash 200GB DDR3 Storage DIMM	N	N	N	N	N	N	N	N	N	N	N	N	N
00FE005	IBM eXFlash 400GB DDR3 Storage DIMM	N	N	N	N	N	N	N	N	N	N	N	N	N

### IBM eXFlash DIMM planning considerations

Consider the following rules when planning for IBM eXFlash DIMMs:

- A maximum of one eXFlash DIMM per DDR3 memory channel is supported.
- At least one RDIMM must be installed in the same memory channel as eXFlash DIMM.
- eXFlash DIMMs only support RDIMMs; other memory types are not supported.
- eXFlash DIMMs with different capacities (that is, 200 GB and 400 GB) cannot be intermixed in the same server.
- eXFlash DIMMs are supported only in memory performance mode; other memory modes of operations (such as lockstep, memory mirroring, and memory sparing) are not supported.

### IBM System x3650 M4 considerations

The x3650 M4 has limited support for IBM eXFlash DIMMs. Only the following x3650 M4 components are supported by IBM eXFlash DIMMs:

- Quantity: Four or eight eXFlash DIMMs; other eXFlash DIMM quantities are not supported.
- Operating system: Red Hat Enterprise Linux 6 Server x64 Edition (Update 4).
- Processor:
  - o Intel Xeon Processor E5-2667 v2 8C 3.3GHz 25MB Cache 1866MHz 130W
  - o Intel Xeon Processor E5-2643 v2 6C 3.5GHz 25MB Cache 1866MHz 130W
  - o Intel Xeon Processor E5-2697 v2 12C 2.7GHz 30MB Cache 1866MHz 130W
  - o Intel Xeon Processor E5-2690 v2 10C 3.0GHz 25MB Cache 1866MHz 130W
- Memory: 16 GB (1x16 GB, 2Rx4, 1.5V) PC3-14900 CL13 ECC DDR3 1866MHz LP RDIMM.
- Adapter: Intel X520 Dual Port 10GbE SFP+ Embedded Adapter for IBM System x.

For more information about the System x servers that support each eXFlash DIMM, see the IBM ServerProven website at the following address:

<http://ibm.com/servers/eserver/serverproven/compat/us/>

## Supported operating systems

IBM eXFlash DDR3 Storage DIMMs are supported by the following operating systems:

- Microsoft Windows Server 2012 R2
- Microsoft Windows Server 2012
- Microsoft Windows Server 2008 R2 (Service Pack 1)
- Red Hat Enterprise Linux 6 Server x64 Edition (Update 5 for the x3850 X6/x3950 X6; Update 4 for the x3650 M4)
- SUSE Linux Enterprise Server 11 for AMD64/EM64T (Update 3)
- VMware vSphere 5.5
- VMware vSphere 5.1 (Update 1)

For the latest information about the specific versions and service packs that are supported, see the IBM ServerProven website at the following address:

<http://ibm.com/servers/eserver/serverproven/compat/us/>

Click **System x servers**, then **Disk controllers** to see the support matrix. Select the check mark that is associated with the System x server in question to see the details about operating system support.

## Warranty

The IBM eXFlash DDR3 Storage DIMMs carry a 1-year, customer-replaceable unit (CRU) limited warranty. When they are installed in a supported IBM server, these modules assume your system's base warranty and any IBM ServicePac® upgrade.

## Physical specifications

The IBM eXFlash DDR3 Storage DIMMs have the following physical specifications.

Dimensions:

- Height: 8.5 mm (0.33 in.)
- Width: 30 mm (1.18 in.)
- Length: 133.3 mm (5.25 in.)

## Operating environment

The IBM eXFlash DDR3 Storage DIMMs are supported in the following environment:

- Temperature: 0 to 70 °C (32 to 158°F)
- Relative humidity: 5 - 95% (non-condensing)
- Maximum altitude: 5,486 m (18,000 ft)

## Related publications and links

For more information, see the following documents:

- IBM US Announcement Letter - IBM eXFlash DDR3 Storage DIMMs (the same Announcement Letter as for IBM System x3850 X6 and x3950 X6):  
<http://ibm.com/common/ssi/cgi-bin/ssialias?infotype=dd&subtype=ca&&htmlfid=897/ENUS114-031>
- *The Benefits of IBM eXFlash Memory-Channel Storage in Enterprise Solutions*, REDP-5089  
<http://www.redbooks.ibm.com/abstracts/redp5089.html>
- *IBM System x Configuration and Options Guide*  
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